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Post Combustion NOx Reduction Tests in a Coal Fired Industrial Boiler, and in Two Coal Fired Utility Boilers

by
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In the past decade Coal Tech has developed and tested a slagging coal combustor attached to an industrial boiler, rated at 20 MMBtu/hr. By staged combustion, with the combustor operating fuel rich and final combustion in the boiler, NOx emissions as low as 0.32 lb/MMBtu have been measured. This compares with 0.7 to 1 lb/MMBtu under fuel lean combustor conditions. The lowest NOx emission levels were obtained at fuel rich conditions in the combustor at stoichiometric ratios ranging from 0.7 to 0.8. However, this was also accompanied by an increase in unburned carbon.

To further reduce the NOx levels and reduce or eliminate the need for fuel rich operation of the combustor, an extensive series of test with post combustion sorbent injection into the boiler were conducted. An aqueous solution containing the sorbent was injected through an atomizer in the furnace region of the boiler. Both the placement and the number of injectors were varied in order to determine the conditions that yielded the most effective NOx reduction. The NOx concentration at the boiler exhaust and the stack were measured. The sorbent utilization and NOx reduction depended primarily on the placement of the injector, and only weakly on the number of injectors. Measured NOx reductions with sorbent injection only ranged from 30% to 70% and sorbent utilization varied from 13% to 62%. Sorbent injection beyond stoichiometric ratios of unity did not improve NOx reduction. The lowest NOx emission measured at the stack was **0.07 lb/MMBtu** with combined fuel rich combustor conditions and post combustion sorbent injection. With fuel lean combustor conditions, the lowest NOx level measured was **0.15 lb/MMBtu.** These levels are below the current EPA standards for coal fired boilers.

Preliminary post combustion NOx reduction tests were also performed on two coal fired utility boilers, rated at 37 MW and 100 MW. The smaller boiler had no NOx control and the emission level was between 0.8 to 1 lb/MMBtu. The larger boiler had low NOx burners and the NOx emission level was between 0.3 lb/MMBtu and 0.4 lb/MMBtu during the tests. The primary test objective in these short duration tests was to evaluate the suitability and performance of the injectors, and only a single and a pair of injectors were used. They did not cover the entire cross-section of combustion gas flow in the boilers. It was determined that the

injectors were suitable for large boilers. The 37 MW boiler tests yielded a peak NOx reduction of 40%, while those in the 100 MWe coal fired boiler yielded a peak reduction of 24%. The larger boiler's NOx performance was found to be very sensitive to the placement of the injectors. These preliminary results indicated that with additional injectors substantially higher NOx reductions would be achieved.. The boilers were not available for more extended NOx reduction tests, and Coal Tech is seeking a large boiler to implement further tests.

It is projected that this process can be implemented on large coal fired boilers at an installed equipment cost of only several dollars per kilowatt, and a consumable cost of less than $400/ton of NOx removed.